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SUBJECT Assessment of Interaction between Magnesium and Carbon Monoxide, by D M Chizhikow (corresponding member of USSR Academy of Science), E I Khazanov, and A G Nikonov, in Izvest Akad Nauk. Otd. tekh Nauk vol II, 10, 1493-1500 (1949)

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INTERACTION BETWEEN MAGNESIUM AND CARBON MONOXIDE

1. The process of reduction of metals having a high vapor pressure is not very effective because during cooling the reaction of reduction partially reverses

$$CO + Me \rightarrow MeO + C$$

and some oxide of the metal is obtained. This reoxidation of metal vapors (reduced by carbon or carbon monoxide) is very intense in the case of light metals. That is the reason why the industry of the USSR uses methods of reduction of the oxides of light metals, particularly of magnesium and calcium, in vacuum with other metals, by carbides and silicides. In such cases only the vapor of the metal to be reduced is present, and there are no complications because of the reoxidation of the vapor. However, thermodynamic calculations of the authors showed that the reduction of magnesium by aluminum, calcium carbide, silicon and silicon carbide is only then of advantage, if the process is performed in a high vacuum. However, this makes the process expensive and limits the production.

Therefore, the authors propose a modification of the reduction process with carbon, according to which the mixture of the reduced magnesium vapor and carbon monoxide is sharply cooled by introducing hydrogen or hydrocarbons. Magnesium is then obtained in a form of fine powder. Instead of hydrogen and hydrocarbons for cooling purposes, the vapors of metals with less vapor pressure than magnesium such as mercury, zinc, cadmium, tin and lead may be used.

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The purpose of the investigation was to establish the rates of oxidation of magnesium powder by carbon monoxide in dependence of the partial pressure of the gas, temperature, degree of dispersion of magnesium and the composition of the powder (as lead was added to it).

The experiments were performed with powder mixtures containing 76.56, 49.78 and 41.26% magnesium (the balance lead) in a carbon monoxide atmosphere. The magnesium grains of the separate samples had the sizes of 0.26 to 0.156, 0.156 to 0.084 and below 0.083 mm in diameter. The already present magnesium oxide content of the metallic samples was 1.05 to 1.15%. The rate of oxidation of the magnesium was determined by measuring the changes in carbon monoxide pressure during the experiments.

The authors came to the conclusions as follows:

The rate of reaction of magnesium with carbon monoxide decreases with decreasing temperature. Below 400° the rate approaches asymptotically to zero. Therefore, the temperature of magnesium vapor has to be quickly decreased below 300° in order to prevent oxidation. The finer the magnesium powder the faster the rate of oxidation at temperatures above 400°C. With decrease in partial pressure of carbon monoxide the rate of oxidation decreases appreciably. The presence of lead decreases the rate of oxidation of magnesium.

2. This investigation was performed in the A A Baikov Metallurgical Institute (Baikov Memorial Metallurgical Institute) of the Academy of Science of the USSR.

The article shows that the methods of vacuum metallurgy were well known in Russia in 1949. But evidently there were difficulties in the industrial application of the method, because of the need for perfect vacuum installations. In order to avoid these installations, and to find a way for work at higher gas pressures, the present experiments, according to the opinion of the referee, were made. However, the design of the experiments seems to be a failure, because lead, added to the magnesium powder does not cool it, but only mechanically prevents oxidation. Nothing is said about the rate of oxidation of the lead itself. Besides, by this method, even in the case of success, pure magnesium powder could never be obtained. The authors advance again the possibility to use gases and hydrocarbons as coolants for magnesium vapors in the carbon monoxide-vapor mixture.

The introduction to this article is broad and elementary. No leading American journal would give space for such an introduction. It is possible that the article was also written for reading by workers in factories.

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